INSTRUCTION MANUAL

NO. 5913

BARBER COLMAN

Wheelco Instruments

models 292 293 297 CAPACITROL

MP MASTER
MA32100

WHEELCO INSTRUMENT DIVISION
BARBER-COLMAN COMPANY, ROCKFORD, ILLINOIS

INDEX

INSTRUCTION MANUAL — MODELS 292 - 293 - 297

ALL INSTRUCTIONS CONTAINED IN THIS MANUAL APPLY TO EACH OF THESE MODELS EXCEPT WHERE NOTED OTHERWISE

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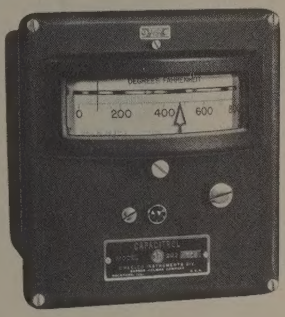
NOTE: This instruction manual to be given to persons responsible for installation and maintenance of this instrument.

UNPACKING INSTRUMENT

This Wheelco Instrument and its associated equipment have been carefully manufactured and packed at the factory. Remove the instrument and accessories from the packing box and check items against the packing slip. If the equipment is found to be damaged in transit, report extent of damage to the carrier immediately. Repack in original packing box until ready for installation.



CAUTION:

Handle with care.

Safeguard instrument from shock.

Avoid oil accumulation.

Keep instrument temperature under 130°F.

MOUNTING INSTRUCTIONS

Locate the instrument to avoid shock, excessive vibration, moisture and temperatures over 130°F. Avoid furnace walls, radiation of heat, machine frames and outside walls. Provide suitable shelter to avoid moisture and temperature extremes if installed outdoors.

Mount instrument approximately level. For surface mounting, remove the meter from the case. Remove the tube from the electronic chassis, and also the two lower corner screws. Then loosen the two rear screws in the slots and remove the chassis. This provides access to three rear mounting holes (See page 4).

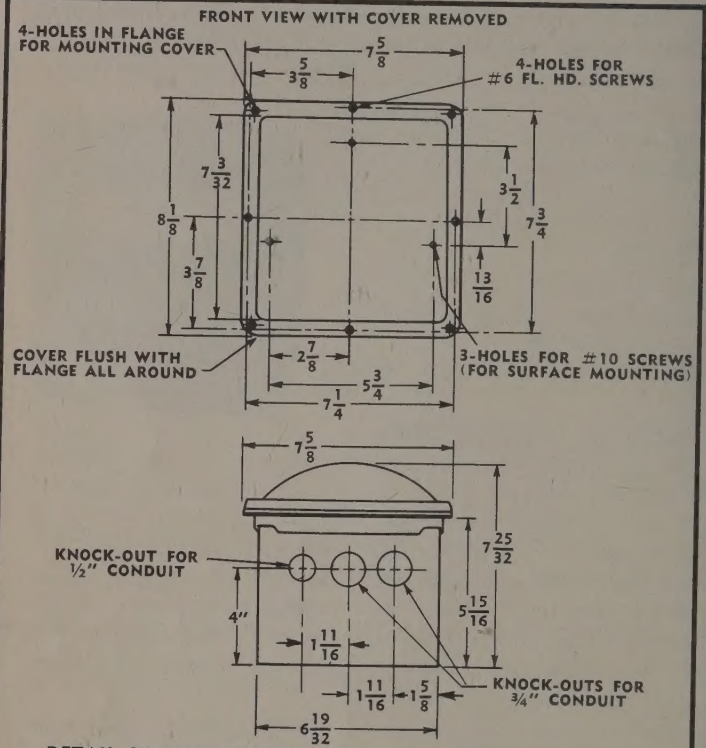
For flush or panel mounting, provide cut-out hole (see dimensions on page 4). Then use the case, with the meter removed, as a template to locate the holes (4 req'd) and use #6 flathead screws.

POWER WIRING

Carefully remove the meter from the case by unscrewing the four corner screws. Check the voltage plug on the front of the electronic control chassis for the proper supply voltage. This voltage should be 105 to 125 volts AC or 210 to 250 volts AC. If available power supply is not that shown on the voltage selector plug, it is necessary only to replace this plug with the plug provided in the envelope.

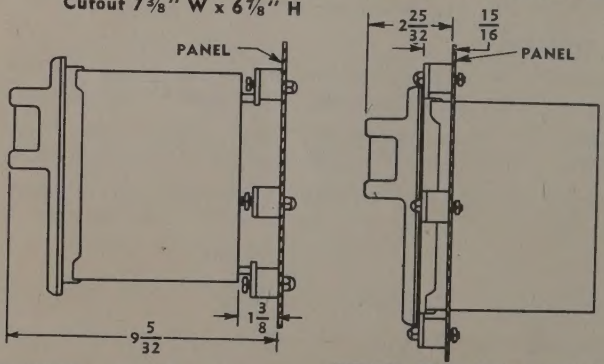
Solid wire (14 ga.) is recommended for instrument wiring. If stranded wire is used, tin the ends to provide secure connections at the "Line" terminals at front of chassis. Run all wires in rigid conduit, BX or Greenfield, in accordance with the recommended electrical code. Position the wires so they do not interfere with control chassis or the housing gaskets. Ground the instrument case; a grounded conduit system is usually sufficient. Use properly fused switches.

MOUNTING DIMENSIONS 292, 293, 297


FRONT VIEW WITH COVER REMOVED
4-HOLES IN FLANGE FOR MOUNTING COVER
4-HOLES FOR #6 FL. HD. SCREWS
COVER FLUSH WITH FLANGE ALL AROUND
3-HOLES FOR #10 SCREWS (FOR SURFACE MOUNTING)
KNOCK-OUT FOR ½" CONDUIT
KNOCK-OUTS FOR ¾" CONDUIT
4"

DETAIL OF PANEL CUTOUT FOR PLAIN FLUSH MOUNTING

Cutout 7⅜" W x 6⅞" H



VIBRATION MOUNT ARRANGEMENT FOR SURFACE MOUNTING

DETAIL OF PANEL CUTOUT FOR VIBRATION FLUSH MOUNTING

Cutout 7½" W x 7" H

USE KIT A2940 FOR VIBRATION MOUNTS

THERMOCOUPLE WIRING

The plug-in terminal strip for thermocouple lead wire connections is located on the right side of the meter.

Use only extension lead wire supplied with the instrument or extension lead wire correct for use with the type of thermocouple specified on the scale. Ordinary copper wire will NOT serve the purpose. Reversed extension lead wires result in wrong readings.

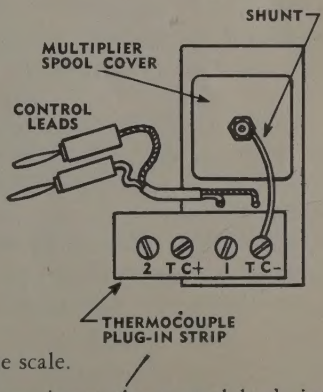
Proper polarity (+) and (—) of the extension lead wire must be observed to obtain true readings. Upscale direction of the pointer movement is not sufficient evidence of correct polarity. Normally, the color coding is indicated on a tag attached to the extension lead wire when shipped. The following procedure definitely checks the correctness of extension lead wire polarity: Attach the lead wire (without the thermocouple) and twist the free ends together; heat the junction thus formed. Deflection upscale means polarity is correct for the lead wire connections to the meter. If the indicating pointer moves downscale, reverse the wires at the meter.

The thermocouple should then be connected to the extension lead wire and the pointer should move upscale when the thermocouple hot junction is heated. If the indicating pointer moves downscale, reverse only the connections at the thermocouple head, since the extension lead wire has already been correctly connected to the meter terminals.

METER SHUNT WIRE

Disconnect the shuntwire just before placing meter housing in the case. This shunt dampens the instrument movement for protection when handling before connecting.

NOTE: Replace the shunt connection when handling or reshipping the instrument. Also position the red control index to the top of the scale.



When placing the meter in the case, insert the control leads into the jacks on the chassis with corresponding colors. On Models 293 and 297, also connect blue wire (No. 1) and green wire (No. 2) from chassis to corresponding terminals on T/C plug-in strip.

MULTIPLIER SPOOL (Resistor R6#A1847)

The R6 resistor is also called the calibrating resistance. The actual resistance is different for each range instrument, and therefore the range is a necessary specification. When the shunt is connected, the R6 resistor is bypassed in the closed circuit which is formed for dampering the meter movement for protection.

The external resistance for which the meter has been calibrated is shown at the bottom of the scale pan and is the combined resistance of the thermocouple plus the resistance of the extension lead wire.

External Resistance Marking on Scale

1. All instruments marked "Ext. Res. 15" or "Ext. Res. 15 + 10" require an External Resistance Compensator Plug which is screwed into one of the T/C terminals on terminal Panel. The resistance of this plug is equal to 15 minus specified value of T/C and T/C lead resistance.
2. All instruments marked other than "Ext. Res. 15" or "15 + 10" (example: Ext. Res. 2.4 + 10) were calibrated for actual value of T/C and T/C lead resistance specified at time of manufacture, and unless installation was changed since that time do not require either the External Resistance Compensator Plug or other form of compensation for external circuit resistance.

THERMOCOUPLE BREAK PROTECTION (TCB)

If the instrument is equipped with Thermocouple Break Protection feature (only when specified) use copper wire (14 ga. satisfactory) to connect the TCB terminals to the connector block in the thermocouple head. The plus (+) terminal should be connected to the plus (+) terminal in the thermocouple head and (—) to (—). Wiring for TCB may be run in the same conduit with thermocouple lead wire. The optional method of connecting TCB is to use TCB connections (jumpers) at the instrument terminals, instead of to the thermocouple head. For more than 10 ft. of lead wire this optional method is not recommended, because of excessive change in reading when instrument power is disconnected, or is poorly regulated.

To check for TCB operation disconnect the thermocouple at the thermocouple head, but leave the TCB wires connected to the lead wire. When the instrument is powered the indicating pointer should deflect upscale above the red control index to cause OFF control action. This simulates a broken thermocouple, with the resulting protection then apparent.

It is seldom necessary to compensate for TCB, which may cause the meter to read insignificantly high when the instrument is powered. It is not necessary where the thermocouple itself has the usual near-zero resistance. Should it be desired to compensate for this upscale deviation, it may be done by shifting the reading downscale as explained in paragraph on METER ADJUSTMENTS.

METER ADJUSTMENTS AND CHECK

The indicating pointer should come to rest at the ambient temperature, when the lead wire is disconnected at the instrument. Use a thermometer as close as possible to the TC instrument terminals to determine the ambient temperature. This is called the cold junction reading since the lead wire, in effect, extends the thermocouple to the TC terminals of the instrument.

If the indicating pointer does not come to rest at the ambient temperature, slowly turn the adjusting screw in the case, located above the center of the scale, to give proper reading. Further deflection as the ambient temperature may change is automatic, since the meter has automatic cold junction compensation.

The above cold junction adjustment is different in case the instrument has TCB which has been compensated for.

To check the effect of Thermocouple Break (TCB), the thermocouple should be held at a steady temperature, while observing the difference in meter readings with the instrument powered and unpowered. If the difference is discernible, compensation may be made with the cold junction adjustment, so that the reading is reduced the slight amount of the difference. The cold junction or ambient adjustment then is changed downscale by this same corrective deflection. An alternate method to make this check is by making and breaking the TCB circuit, rather than through off-on power to the instrument.

CONTROL SPECIFICATIONS MODELS 292, 293, 297

The MODEL 292 is an on-off, or H, C, L two position control, with contact rating of 10 amp. at 115 volts or 5 amp, at 230 volts for non-inductive loading. For inductive loading decrease ratings by 50%.

MODELS 293 and 297 are general purpose time proportioning control instruments of the pulsing type. The proportioning, or pulsing action, is for reducing over and undershooting of temperature. The proportioning effect is adjustable with a rheostat on the chassis to the left of the pilot lamp. The factory setting is usually adjusted for

minimum effect. The switch ratings are 10 amp. at 115 volts or 5 amp. at 230 volts. For inductive loading decrease ratings 50%.

DESCRIPTION OF ELECTRONIC CIRCUIT

The MODEL 292 includes the Wheelco Electronic Link which uses a small flag on the meter pointer, and two flat coils on control pointer. These engage without contact at the control setting position to change an oscillator output to an amplifier for operating the control relay.

MODELS 293, 297 have a pointer flag and coils on the control setting arm. In addition, a "Capaciline" proportioning system is added which moves the indicating pointer upscale slightly ahead of the normal upscale deflection. The initial temperature overshoot is thus reduced due to the pointer passing the control set-point ahead of time. As the relay changes position an opposite, or downscale action is started, and this reversal occurs each time the pointer crosses the control point and imparts a small swing to the pointer.

The proportioning band width depends on the amplitude of the up and down swing of the pointer, and the proportioning action is the result of how far the pointer passes above the red control index, along with the corresponding underswing. The Capaciline adjusting rheostat changes the resistance of the circuit which causes pointer to swing, effectively changing width of the proportioning band. An added effect, when the rheostat is turned toward maximum, will increase the rate of cycling. Unnecessary cycling should be used sparingly due to increased wear on the associated equipment, including the heater elements where used. A manual tuning adjustment compensates for "droop" or control offset.

OPERATION

All Models have an adjustable control set pointer geared to a knob directly below the indicating scale, for external positioning.

The control relay requires that the associated electronic tube has approximately 20 seconds for warmup. Then the red signal light below the setting knob brightens to indicate "Heating" with the H-C-L terminals made between C to L (temperature low). As the temperature rises and the indicator crosses the red control set pointer, the control relay darkens the signal light and transfers the contact from C to L and makes C to H (temperature high, or OFF). In some cases a minimum heat input is used instead of fully off, which gives high-low control, rather than the basic 2 position ON-OFF control.

The indicator is deflected by DC current generated by the control thermocouple at its hot junction. (Type of thermocouple is shown on scale). The indication part of the instrument uses no other power such as dry cells or rectifiers.

MODEL 293 and MODEL 297—In these models there is an anticipating control effect produced by the internal "Capaciline" unit. This is a form of proportioning control causing the indicating pointer to cross the control set point a little before the normal time of crossing (if the thermocouple alone were deflecting the pointer). As the control shuts off, the relay reverses this superimposed anticipating effect. This reversal begins gradually after the upscale effect decays. This delay in reversal is controlled by a rheostat with a capacitor losing its charge gradually. Then the reverse anticipating effect causes the cooling indication to cross the control set point slightly ahead of the thermocouple rate of cooling. This effect in turn decays after the control point is passed, and the upscale action then starts. The upscale and downscale indication continues after the thermocouple temperature "lines out" which produces a pulsing, or duration type control, which automatically heats, and then shuts off (usually occurring several times a minute). This action holds the load temperature constant at the thermocouple.

The proportioning band adjustment widens or narrows with the adjusting screw at the left of the pilot jewel, which also increases the pulsing rate when the band is widened. Slow temperature changes usually need near minimum proportioning adjustment which also has slower pulsing.

Most applications favor a moderate pulsing rate adjustment, with corresponding narrow proportioning band, consistent with acceptable temperature, or other process control.

CONTROL ADJUSTMENTS

MODEL 292—The control adjustment is accessible from the front of the instrument with the meter installed. It is to the right of the pilot jewel inside the instrument case and requires a small insulated screwdriver to reach through a hole in the front of the case, with the threaded plug removed.

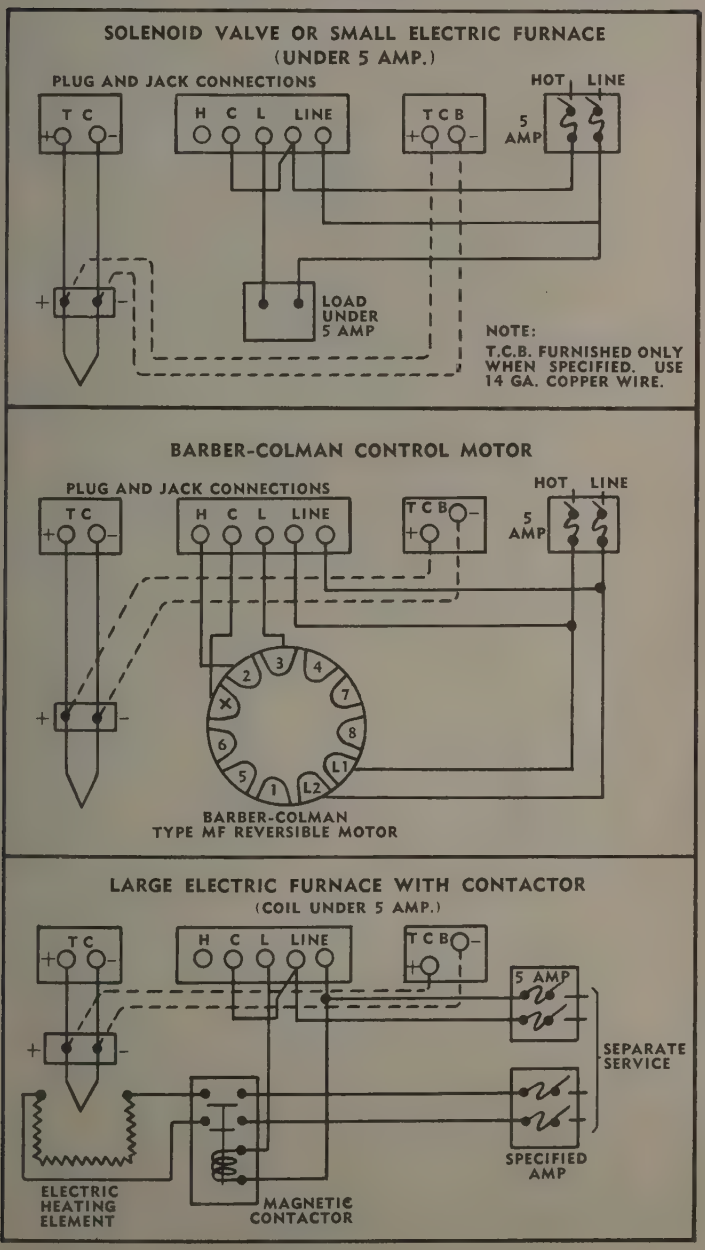
This adjustment is for alignment of the control action, to cause it to occur at coincision of the indicating pointer with the red control set point. If control operation does not occur at coincision, remove the plug and turn the tuning adjustment slightly to the left to shift the control action upscale, and vice-versa.

MODEL 293 and MODEL 297—The alignment adjustment (tuning) and the Capaciline proportioning adjustment are both accessible through holes in the front of the case. The holes are closed with threaded plugs, the larger being to the right of the pilot jewel for using an insulated screwdriver for tuning. The other hole to the left is smaller for a plain screwdriver to adjust rheostat.

The right side adjustment shifts the entire proportioning band upscale when adjusted slightly to the left, and vice-versa. This tuning adjustment for alignment is also known as "RESET", since it is used to correct control offset, or "droop", if the preliminary adjustment results in the temperature indication "lining-out" either up or downscale from the red control set point. A very small adjustment will cause an appreciable change, but the full effect requires several minutes to become uniform, with large furnaces taking longer.

The proportioning adjustment to the left of the pilot jewel, is not calibrated. It is usually adjusted to the minimum position by the factory. Greater proportioning effect is obtained by turning the rheostat to the right in gradual steps, and observing the improved control action after sufficient time for the correction to become apparent. More proportioning effect than needed causes extra pulses each minute, which is not good practice for obtaining maximum instrument life.

EXTERNAL WIRING DIAGRAM — ALL MODELS



WHEELCO MODEL 293 - 297
INTERNAL WIRING DIAGRAM

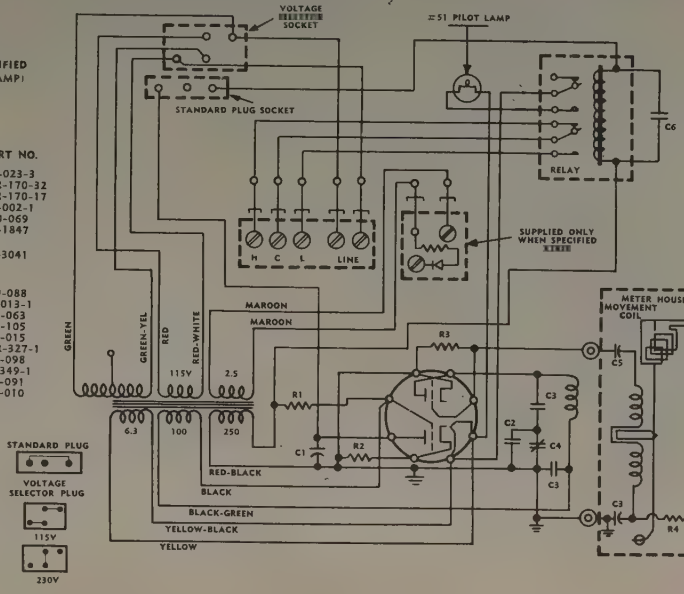
WHEELCO MODEL 292
INTERNAL WIRING DIAGRAM

(FOR MODEL USING CONTROL CHASSIS IDENTIFIED BY 6.3 VOLT NO. 51 BAYONET BASE PILOT LAMP)

DRAWING SYMBOL	VALUE	PART NO.
R1	47 K	40-023-3
R2	470 OHM	CYZR-170-32
R3	2.7 MEG	CYZR-170-17
R4	200 K	40-002-1
R5	NEG. COEFF. RES.	40-069
R6	CALIBRATING RES. *SPECIFY RANGE*	A-1847
R7	EXTERNAL RESISTANCE COMPENSATING PLUG	A-3041
C1	.0047 MFD	39-088
C2	15 MMF	39-013-1
C3	.001 MFD	39-063
C4	8-50 MMF	39-105
C5	25 MMF	39-015
C6	8 MFD	CYZR-327-1
C7	1 MFD	39-098
	RELAY	A-3349-1
	TRANSFORMER	30-091
	TUBE (6SN7)	31-010

NOTE.

1. FOR 115V INSTRUMENT PLACE 115V PLUG INTO VOLTAGE SELECTOR SOCKET.
2. FOR 230V INSTRUMENT PLACE 230V PLUG INTO VOLTAGE SELECTOR SOCKET.
3. THIS DIAGRAM EFFECTIVE DECEMBER 1958
4. CIRCUIT RESONANT ON CALL FOR HEAT
5. A-3742 CHASSIS CIRCUIT



If calibration is high, (illegible) wire

WHEELCO MODEL 292
INTERNAL WIRING DIAGRAM

METER MAINTENANCE AND SERVICING

The same basic meter heads (removable front with meter) are used on Wheelco Models 292, 293, 297, and the information for emergency servicing applies to each of these models.

In case of trouble, the serviceman should familiarize himself with the function of the instrument as applied. Measurement trouble, when known to be in error, should be treated separately from control trouble, even where both may be present.

The following checking applies to the temperature measuring, i.e., meter head, thermocouple, and leadwire.

Check for:

(1) Open or broken thermocouple, leadwire, or connector.

(2) Deteriorated thermocouple. A comparison of readings using a test thermocouple is best, even where the service thermocouple appears unchanged or almost new.

(3) Accidental shorts and grounds in the thermocouple and leadwire, and moisture in the leadwire (especially with asbestos type insulation).

(4) Correct polarity of thermocouple and leadwire. If leadwire has been spliced, check each splice to discover a possible double reversal which causes low readings.

(5) Check for vibration or shock.

(6) The accuracy of the meter itself may be checked with a Wheelco Model 330, or equivalent potentiometer checking instrument.

(7) Check against oil or grease. Do not oil or grease any part of the instrument.

(8) Correct cold junction (ambient) setting before and after checking the meter.

(9) If necessary to remove meter, replace shunt as soon as possible for protection of the meter, and move the control pointer to the top of the scale.

CONTROL MAINTENANCE AND SERVICING

If the controlled temperature is not maintained at the control point normally, check the following:

(1) Electrical connections, and line voltage. Voltage at the line terminals should be between 105-125 V. or 210-250 V. Ascer-

tain that the instrument, and not external trouble exists.

(2) Be sure the tube and plug-in strips are well inserted in their sockets.

(3) Replace the electronic tube in the event tuning adjustment does not restore control action.

(4) Take advantage of the plug-in features where other instruments of the same type are available. Replace the chassis.

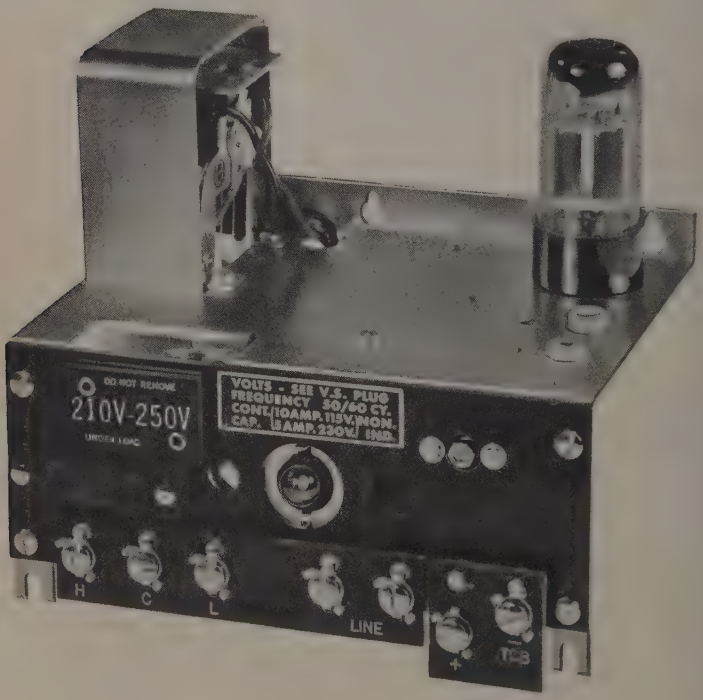
(5) On Proportioning Models 293, 297 check the control ON-OFF action with the proportioning adjustment at minimum (left-side adjustment turned fully to the left). The relay action should be definitely on or off with the pointers separated by as little as 1/16 inch (similar to the Model 292).

(6) The relay current may be checked with a check plug-in strip and a test meter. Use plug-in strip A 2632 and a O-20MA DC meter. Normal tube output to the relay in the ON position is 8 to 11 MA and 2MA or less in the OFF position.

(7) Replace the electronic tube yearly, since the cost is little compared to possible service interruption.

SUGGESTED REPLACEMENT PARTS

MODEL 292	Part No.
Electronic Tube (6SN7)	31-010
Thermocouple	Specify
Mazda Pilot Lamp	36-022-1
Chassis Assembly with Pilot Bulb less Voltage Plug, Standard Plug, HCL-Line Plug and Tube — 60 cycle	A-3742



SUGGESTED REPLACEMENT PARTS

MODEL 293-297	Part No.
Electronic Tube (6SN7)	31-010
Thermocouple	Specify
Mazda Pilot Lamp	36-022-1
Chassis Assembly with Pilot Bulb less Voltage Plug, Standard Plug, HCL-Line Plug and Tube — 60 cycle	A 3743

Warranty and Inspection Card — PLEASE FILL OUT AND RETURN

This equipment is guaranteed in accordance with the statement of warranty appearing on our quotation and acknowledgement forms. Upon receipt of this card properly filled out Warranty becomes effective. All Wheelco instruments are manufactured to the highest standards of quality and are carefully inspected before packing. Instruments which have been damaged or fail to operate upon installation, should be reported to the factory at once.

Wheelco Instruments Division
Barber-Colman Company

MODEL NO.
SERIAL NO.
CALIBRATION INSP.
FINAL INSPECTION

Date Received		
Company		
Street		
City	Zone	State
By		Title

COMMENTS

MP MASTER
MA32100

F-9716

LITHO IN U. S. A.